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MECHANICAL ENGINEERING
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Consulting Report : MT0499

SOUND POWER LEVEL TESTS ON AN AIRCONDITIONING DIFFUSER

Ben S. Cazzolato

12th February, 1999

Checked by : Professor Colin H. Hansen

Report Distribution:
Client (1)
MECHTEST (1)
Author (1)

Prepared For:
Vladimir Petrovic
DadanCo Pty. Ltd.
2/49 Holland Street
Thebarton SA 5031

Department of Mechanical Engineering
The University of Adelaide
South Australia 5005
Telephone +61 8 8303 5460
Facsimile +61 8 8303 4367

Operating through Luminis Pty. Ltd.
A.C.N. 008 027 085
Incorporated in South Australia
University of Adelaide
South Australia 5005

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1 INTRODUCTION

This report details the results of the Sound Power Level measurements performed on an airconditioning diffuser for Dadanco Pty. Ltd. on 12th February, 1991.

These tests were conducted at the Reverberation Chamber in the Department of Mechanical Engineering, University of Adelaide.

2 RELEVANT STANDARDS

The tests and data analysis were carried out in accordance with the following standards:

i) AS 1217 - 1985 Acoustics - Determination of Sound Power Levels of Noise Sources.

ii) AS 1045 - 1988 Acoustics - Measurement of Sound Absorption in a Reverberation Room.

iii) AS Z41 - 1969 Octave, Half Octave and One-third Octave Band Pass Filters - Intended for the Analysis of Sound and Vibration.

3 DESCRIPTION OF TEST SPECIMEN & TEST FACILITY

The test specimen comprised an airconditioning diffuser unit mounted approximately 2m from the closest wall.

The test facility is situated at the Department of Mechanical Engineering Acoustic Laboratories at the University of Adelaide. This facility has been NATA approved for measurements in third octave bands from 125 Hz to 4 kHz. Details of the room is given in Table 1.

	Reverberation Room
Room Dimensions	4.720m x 6.840m x 5.656m 1.45 : 1.18 : 1
Surface Area Volume	193.2 m^2 179.7 m^3

Table 1 : Reverberation Room Specifications

4 INSTRUMENTATION

The microphone was calibrated prior to testing using a B&K Type 4220 Pistonphone. Sound pressure levels were measured with a B&K Type 4165 1/2" High Sensitivity Condenser Microphone and a B&K Type 2604 Microphone Preamplifier in the Reverberation room Reverberation times were not measured during these tests. For the Sound Power Level calculations, reverberation times from a previous test with a similar configuration was used instead (report MT4094 for Mitsubishi Motors Australia Ltd.). A HP 35665A Signal Analyser with 1/3 Octave Filters was used to measure the sound pressure levels in each room.

All the equipment used during the tests is maintained in accordance with the manufacturers recommended procedures by qualified personnel in the Mechanical Engineering Department Acoustic Laboratory.

5 METHODOLOGY

The Sound Pressure Levels were measured at 2 separate locations and then averaged. Usually the microphone traversing system is used to obtain the space averaged sound pressure levels but due to the very low sound power levels generated by the source it was necessary to turn off the traverse since this was responsible for increasing the background noise levels. In attempt to further reduce the background noise levels the rotating diffuser was not used. Time and space averaged reverberation time in the Receiver Room were obtained from report MT4094.

5.1 MEASUREMENT PROCEDURE

The time and space averaged Sound Pressure Levels (SPL) in the Source and Receiver Rooms were measured at 2 locations by a 1/2" microphone.

It should be noted that the Australian standard AS 1217.2 requires that at least 3 microphone positions are used. However, at the request of the client only two microphone locations were used in the interests of reducing the time taken for the tests. It is not believed that this will significantly alter the reported sound power levels for frequencies above and including 250 Hz.

The SPL's were measured by a HP 35665A Signal Analyser. The SPL was averaged for a time, t_{av}, not less than that specified in Clause 5.2.2 AS 1217.2 - 1985. The background noise levels were measured to ensure that the noise levels during testing were at least 10 dB greater.

5.2 CALCULATIONS

Sound Power Level produced by the diffuser is given by (Beranek 1971)

$$L_w = L_p + 10\log_{10}(V) - 10\log_{10}(T_{60}) + 10\log_{10}(1+S\lambda/8V) \qquad (1)$$

where,

L_w = the sound power level of the source, (dB re 10^{-12} Watts),
L_p = the sound pressure level measured in the room, (dB re 20×10^{-6} Pa),
V = the volume of the room, (m^3),
S = the surface area of the room, (m^2),
T_{60} = the reverberation time of the room, (s),
λ = the wavelength of the sound, (m).

6 RESULTS

The results of the sound power levels measurements for the 7 flow rates are presented in Tables 2 and 3 for the third-octave and octave data respectively. This is also presented graphically in Figures 1 and 2.

SPL's during testing were at least 10 dB greater than the background noise levels unless otherwise indicated in Table 2 and 3. Calibration of the microphone instrumentation was conducted before and after testing the panels and is presented in Table 4.

1/3 Octave Centre Frequency (Hz)	No+ Flow +10 dB	100 Pa	150 Pa	200 Pa	215 Pa	250 Pa	300 Pa	350 Pa
63	32	36	46	51	48	52	52	53
80	33	39	46	53	54	55	56	57
100	33	36	41	47	48	51	55	57
125	32	35	41	44	45	48	51	52
160	35	35	40	44	43	46	47	49
200	29	39	41	43	44	45	47	47
250	22	37	42	45	45	46	47	49
315	20	39	43	46	47	48	49	50
400	18	35	40	44	45	47	49	50
500	24	33	38	43	44	47	49	51
630	19	38	39	39	41	44	46	47
800	17	30	34	38	39	42	44	46
1000	19	30	37	39	39	41	43	45
1250	18	25	33	39	40	42	43	44
1600	19	25	29	33	34	38	42	44
2000	18	23	29	33	34	36	38	40
2500	19	22	27	32	32	35	37	39
3150	20	20*	27	31	31	34	36	38
4000	21	21*	25	31	31	34	36	38
5000	23	23*	26	31	32	35	37	39
6300	24	24*	25	31	32	35	38	40
8000	26	26*	26*	33	34	38	41	43

* Measured levels did not exceed background levels by 10 dB.
+Equivalent background sound power levels + 10dB

Table 3 : Third-Octave Sound Power Levels of the diffuser.

1/3 Octave Centre Frequency (Hz)	No Flow +10 dB	100 Pa	150 Pa	200 Pa	215 Pa	250 Pa	300 Pa	350 Pa
63	37	42	51	57	55	58	59	60
125	37	42	48	54	55	57	59	61
250	30	43	47	50	50	51	53	54
500	26	41	44	47	48	51	53	54
1000	23	33	40	43	44	46	48	50
2000	23	28	33	37	38	41	44	46
4000	26	26*	31	36	36	39	41	43
8000	30	30*	30*	37	37	41	44	46

* Measured levels did not exceed background levels by 10 dB.

Table 4 : Octave Sound Power Levels of the diffuser.

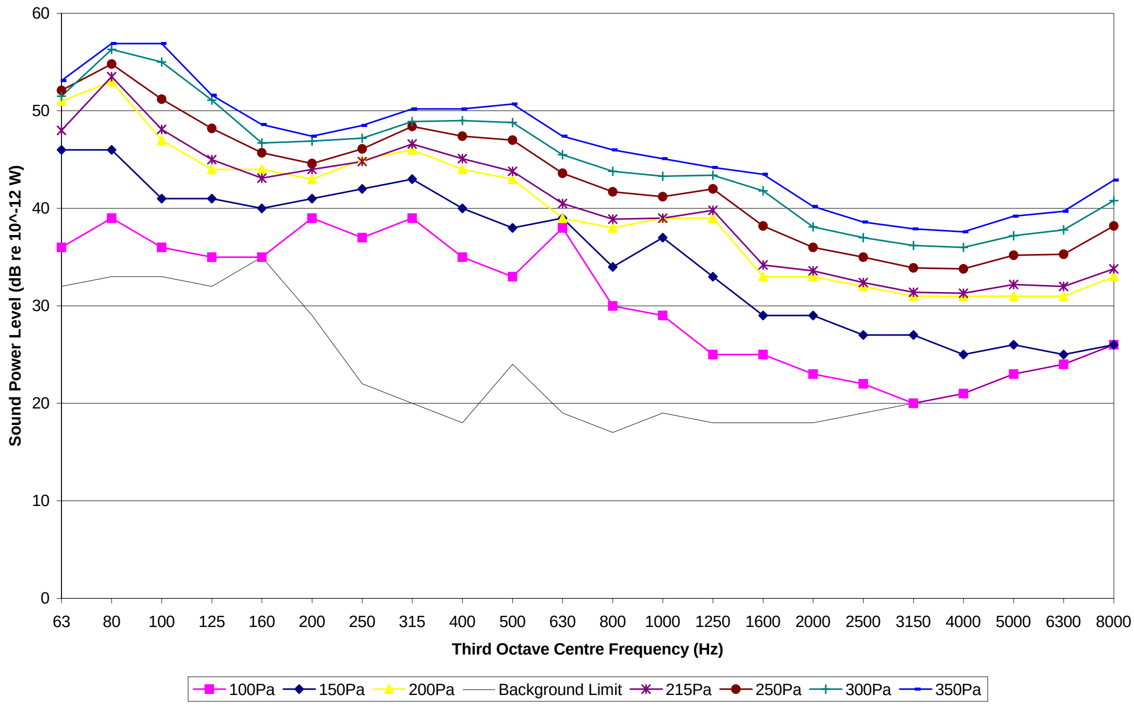

Figure 1 : Third-Octave Sound Power Levels

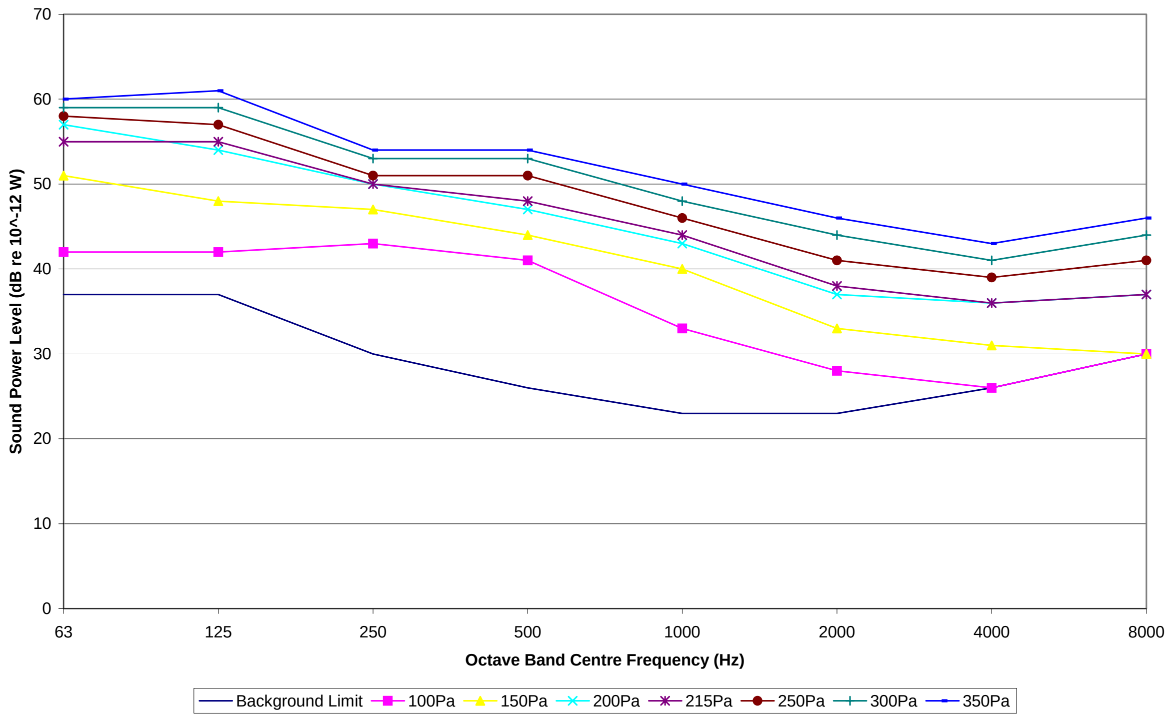

Figure 2 : Octave Sound Power Levels

Reverberation Room	
Before	After
124.0 dB	124.1 dB

Table 4 : Microphone Calibration Details

7 COMMENTS

The octave band sound power levels have been calculated by summing the sound power of the three third octave sound power levels within the octave band. It should be noted that since the 50 Hz and 10 kHz third-octave bands were not available, it has been assumed that the third-octave values were equal to the sound power level of the closest adjacent band, namely 63 Hz and 8 kHz respectively. This is believed to be a valid assumption due to the low variance of the sound power levels with respect to frequency.

APPENDIX A - Raw Data